

## Abstract of the Disclosure

This invention comprises an apparatus and method for sonic welding and materials forming by *superposition* of high-power-density *sonic shear wave* and *sonic compression wave impulses* directed by a *sonic lens* into a workpiece. The shear impulse is induced by refraction and mode conversion of a compression impulse. Materials subject to shear impulses are transformed from solid-to-viscoelastic state. The compression impulse is superposed on the shear impulse. *Welding* is effected by shear induced viscoelasticity, combined with quasistatic and dynamic compressive stress, at interfaces among workpiece elements. Further, superposed shear and compression impulses are applied to *fuse, shape, and transform materials*.

The apparatus functions with a range of energy sources. The shear impulse is partitioned from the compression impulse. Waveguides may be applied for impedance matching among the energy sources, sonic lenses, and workpiece. The present invention relates to solid state welding, materials forming, fusion, cohesion, adhesion, and substructure modification.